EVALUATION OF A DEVICE TO TRAIN FORWARD AIR CONTROLLERS TO COMMUNICATE TARGET LOCATIONS

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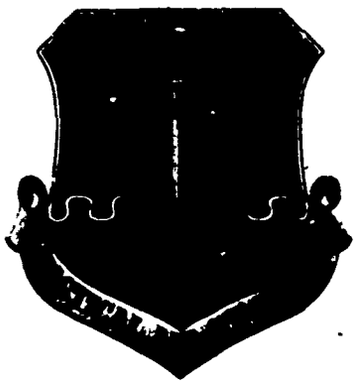
Joint AFSC/TAC Study



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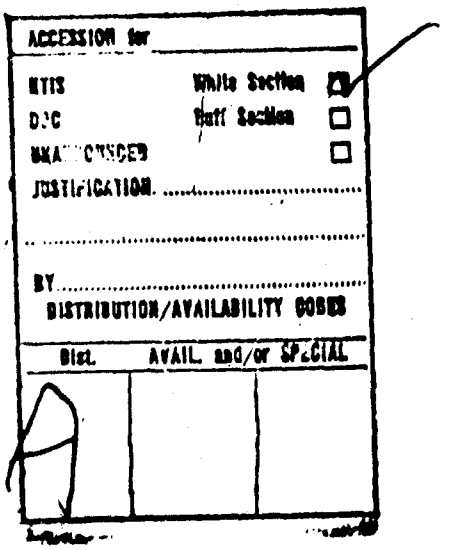

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FOREWORD

The research described in this report was a joint effort of the Advanced Systems Division of the Air Force Human Resources Laboratory (AFHRL), Air Force Systems Command and the Tactical Air Command. This effort is documented by AFHRL under Project 1710, "Training for Advanced Air Force Systems," Task 171003, "Training Implication of New Technology." Dr. Ross L. Morgan is the Project Scientist and Mr. Horace H. Valverde is the Task Scientist.

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Training Research						

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ABSTRACT

This report describes the development and evaluation of a forward air controller (FAC) and tactical strike pilot (TAC) trainer. The trainer was designed to permit a FAC and a TAC to practice the tasks of communicating the location of targets. A previous analysis of communications between FAC and TAC personnel during actual combat had revealed that the task of verbalizing imagery (describing what one is seeing) was especially difficult and important to the success of the FAC/TAC mission. Subjects for the evaluation consisted of 35 Air Force pilots selected to be trained as forward air controllers at Hurlburt Field, Florida. The subjects were divided into 2 groups: Group A (N=18) received a one-hour pretest, two hours of supervised practice, and then a one-hour posttest. Group B (N=17) received only a one-hour pretest and a one-hour posttest. The achievement in gain of Group A was significantly greater than that of Group B. The results of a student questionnaire indicated that the FAC students enthusiastically endorsed the use of the trainer in teaching communication of target locations. The results of transfer of training were inconclusive. These results about transfer are not surprising because performance in the aircraft was evaluated using a subjective and rather gross scale.

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SUMMARY AND CONCLUSIONS

PROBLEM

An analysis of combat recordings showed the frequency and duration of the items that the forward air controller (FAC) and the tactical fighter pilot (TAC) mutually discuss. The problem of verbalizing imagery (describing to another person what one is seeing) was revealed as a critical FAC/TAC task that appears to depend extensively on subjective skills such as choosing and relating landmarks. The problem was to devise a relatively simple, yet effective, means for training FAC personnel in this important skill.

APPROACH

A FAC/TAC trainer was developed primarily to provide practice in voice communications of target locations. To evaluate the trainer, a total of 35 Air Force FAC students used it to practice communicating location of targets. The students were divided into 2 groups: Group A (N=18) and Group B (N=17). Group A students received a one-hour pretest, two hours of supervised practice, and then a one-hour posttest on the trainer. Group B received only a one-hour pretest and one-hour posttest. The students' average total flying time was 651 hours. None of the students previously had received specific training in communicating target locations. The program consisted of 3 phases: (1) pretest, (2) supervised practice sessions, and (3) posttest Group B did not participate in the supervised practice session. Group A and Group B subjects were pretested and posttested on an individual basis. However, 2 students operated the trainer during each 2-hour practice session. They alternated roles as FAC for 1 hour and as strike pilot for 1 hour.

RESULTS

Ratio gain scores were calculated for each subject for the pretest and posttest. The gain of Group A was significantly greater than that of Group B (Mann-Whitney U : Z=2.475, probability was greater than .05). A questionnaire designed to measure the attitude toward the trainer was administered to the students. A "general satisfaction" or "favorable attitude" score was obtained for each group. In general, the students enthusiastically endorsed the use of the trainer to provide skills in communicating target locations to strike pilots. Of the 35 students responses, only 3 indicated negative attitudes toward the trainer. Although transfer of training from trainer

to aircraft was not originally included in the experimental design because of the stringent training schedule, arrangements were made during the test to obtain flight instructor appraisals on some subject (N=8 for each group). Although the mean scores slightly favored Group A students, the differences between means of the 2 groups were not significant.

CONCLUSIONS

The trainer can be used to teach communication of target location which seems to require an unusual amount of subjective judgment or experience on the part of the FAC student. This low cost device also could be used for remedial instruction in target detection, recognition, and identification. It is presumed that the use of motion picture imagery in the trainer would provide real-time training of even greater benefit.

It is emphasized that the trainer is a part-task trainer. It was designed to increase the ability of the slow, low-flying FAC in transferring target location information. The trainer was not designed to address all aspects of the FAC/TAC operation.

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Section I

INTRODUCTION

PURPOSE

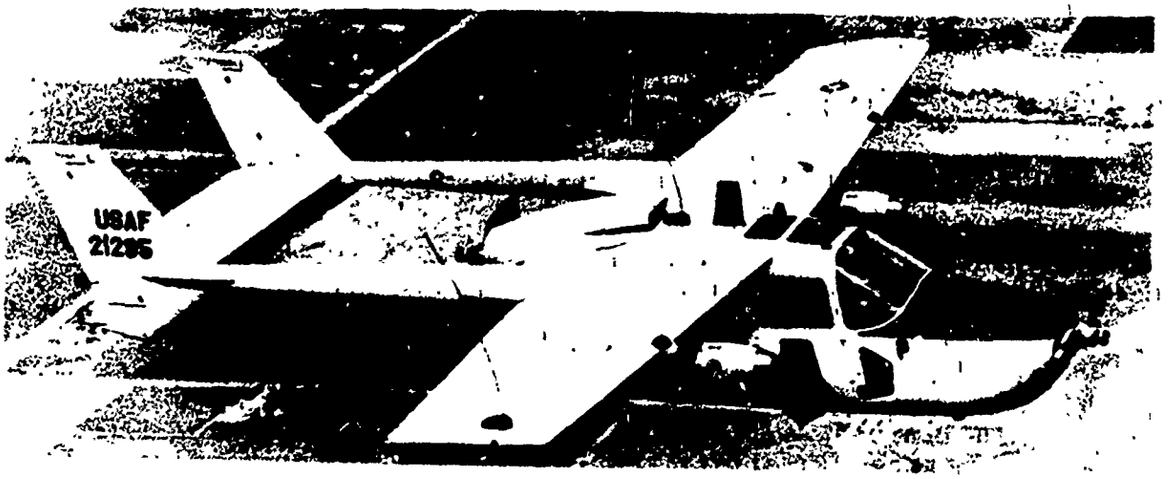
This report describes the development and evaluation of a part-task trainer. The trainer was designed to help the airborne forward air controller (FAC) to become more proficient in communicating target locations to the faster, higher flying tactical strike pilot (hereafter referred to as the TAC).

PROBLEM

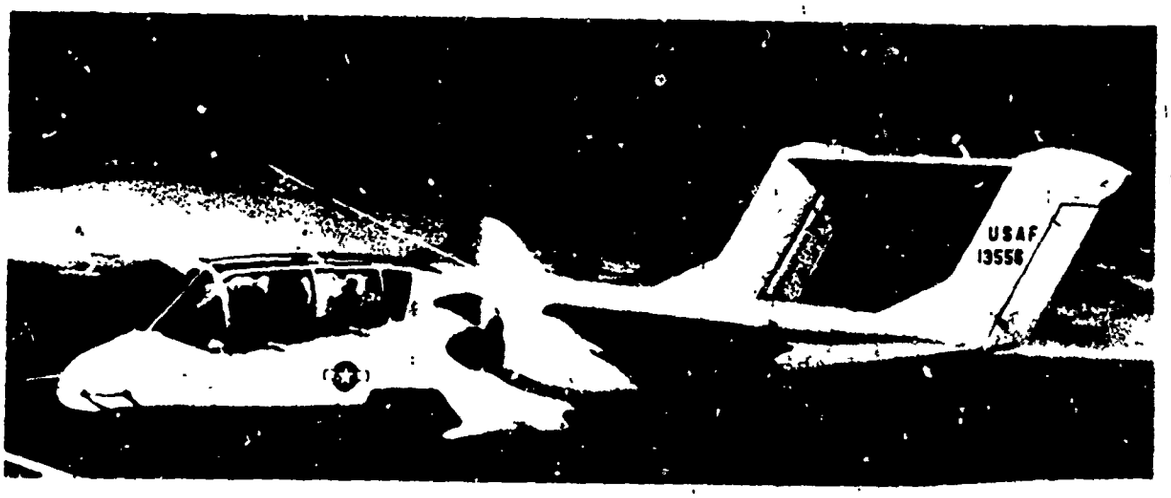
In limited war/counterinsurgency operations, the FAC and TAC engage in airstrikes in (1) close support of ground forces and (2) those not in support of ground force activities. Also, the FAC performs visual reconnaissance missions which do not include airstrikes. During strike operations, pilots of tactical aircraft are directed by FAC pilots who operate relatively slow, low-flying aircraft such as the O-2 and OV-10 (Figure 1). Because of the difference in altitude, speed, and spatial orientation of the two viewers, this often is a difficult task.

ROLE OF THE FORWARD AIR CONTROLLER

The role of the forward air controller has evolved in both complexity and responsibility over the past 50 years. The first record of a FAC directing aircraft supporting ground forces occurred shortly after World War I. At that time, panels were placed on the ground to indicate the distance and direction of the target from the friendly position. In the beginning of World War II, the Germans improved on this technique by assigning FACs to Panzer units as these armored units moved across Western Europe. The controllers communicated by radio with Stuka aircraft which flew overhead on alert in support of the armored columns. Also, during World War II, FACs were assigned to assist United States ground commanders in the use and control of tactical air support. They had radio equipment mounted on jeeps which permitted their control of attack aircraft.



A. Cessna O-2



B. North American OV-10

Figure 1. Low Altitude Aircraft Used by FACs to Guide Fighters to Targets in Southeast Asia

During the latter part of World War II, employment of USAF airborne FACs was initiated. These controllers, flying L-5 Stenson aircraft, were used to direct artillery, perform visual reconnaissance, and direct air strikes. Although not specifically trained in the air control mission, they demonstrated the flexibility and improved visibility of the airborne FAC.

During the Korean War, further use was made of airborne FACs. These FACs, called "mosquitoes" were employed to direct strikes in support of the ground situations and target descriptions improved the effectiveness of tactical air support. (Reference 1). The general procedures and techniques developed then have been used in Vietnam with corresponding effect.

The duties of a FAC are varied and his responsibilities are greater than might be expected of a junior grade officer. These duties include more than just controlling a close air support strike. He advises the ground commander on the use of all the support a tactical Air Force can provide and he assists in planning for this support.

Our primary concern in this study is the control of a close air support mission and the verbal communication that must take place between the strike leader and the FAC. The strike lead pilot contacts the FAC on a preselected radio channel and gives him essential information such as number and type of aircraft, amount of ordnance, time he can remain in the area, and other information that may be unique to that flight. When the FAC receives this information, he gives the fighter a briefing on the target, terrain, weather, and particularly the ground situation. This briefing may be given as the fighters are directed into the area or as they hold over an orbit or control point. Next follows one of the most difficult aspects of a FAC's duties. He must make sure the strike leader sees the target or target area. Many techniques can be used to achieve this objective. The easiest way is to mark the target from an airborne platform. Normally, the fighter aircraft will have the FAC in sight and watch him roll in to fire a rocket which will mark the target. However, many circumstances might preclude the FAC from marking and he must verbally describe the target. Some of these circumstances might be heavy ground fire, the desire for complete surprise, or the FAC has no marking rounds left. When the fighter aircraft has the target area in sight, the control of the strike is very simple. The FAC needs only to clear each fighter as it attacks the target (Reference 2).

Unlike conventional warfare, limited war/counterinsurgency activities are not based on well-defined battle lines and tactics. Although the targets cues very often are subtle, the FAC, nevertheless, must detect, recognize, and identify the elusive enemy. To accomplish this, he should develop a memory image of his area of responsibility which then becomes a frame of reference for evaluating real-time perceptions (Reference 3). Thus, the FAC can compare presently available environmental cues with the memory image in an effort to detect, recognize, and identify a target of opportunity. However, when the FAC identifies a target, he must be able to communicate its location to the higher flying TAC. The trainer developed for this study was designed to provide practice in target location communications to improve FAC/TAC operations.

SECTION II

THE FAC/TAC TRAINER

TRAINER DESIGN CONSIDERATIONS

Although the task requirements for communication of target locations could not be determined by conventional task analysis, an alternate approach was used. Computer-based data on Southeast Asia combat recordings of communications between FACs and TACs were used to obtain training requirements. A total of 20 combat missions was analyzed. The data obtained for the requirements were based on 5,283 FAC and TAC comments. The results suggested what the trainer should reproduce. The analysis indicated that 53.7% of the FAC's communication task was concerned with verbalizing the location of targets, aircraft, people, and guns (Reference 4).

In addition to fulfilling its training mission, major considerations in the design of the trainer were that it must be economical, easily assembled, and transportable (Figures 2, 3, and 4). Emphasis was placed on psychological simulation as opposed to engineering simulation. The reason is that as the degree of engineering simulation increases, the costs rise at an increasing rate. All too often, the increased costs do not produce commensurate increases in training value. Psychological simulation, or simulating those aspects of tasks that will produce high transfer to operational performance, requires thorough attention to the objectives of any given trainer. Without such attention, there may be a tendency to add unnecessary hardware or frills (at greatly increased costs) to a trainer. This caution was especially pertinent to the design of the present trainer because its purpose was that which could be fulfilled by a part-task trainer.

TRAINERS VERSUS OPERATIONAL EQUIPMENT

Frequently, operational equipment is considered to be the most effective and valid training equipment. However, this is not true in every instance. In fact, sometimes it may be undesirable to use real equipment for training if suitable trainers are available for the purpose. For example, operational training and testing have several disadvantages which include (1) high equipment costs, (2) limitation on practice of varied aspects of tasks, and (3) safety hazards. Practical decisions in the use of training devices depend upon compromises between economic

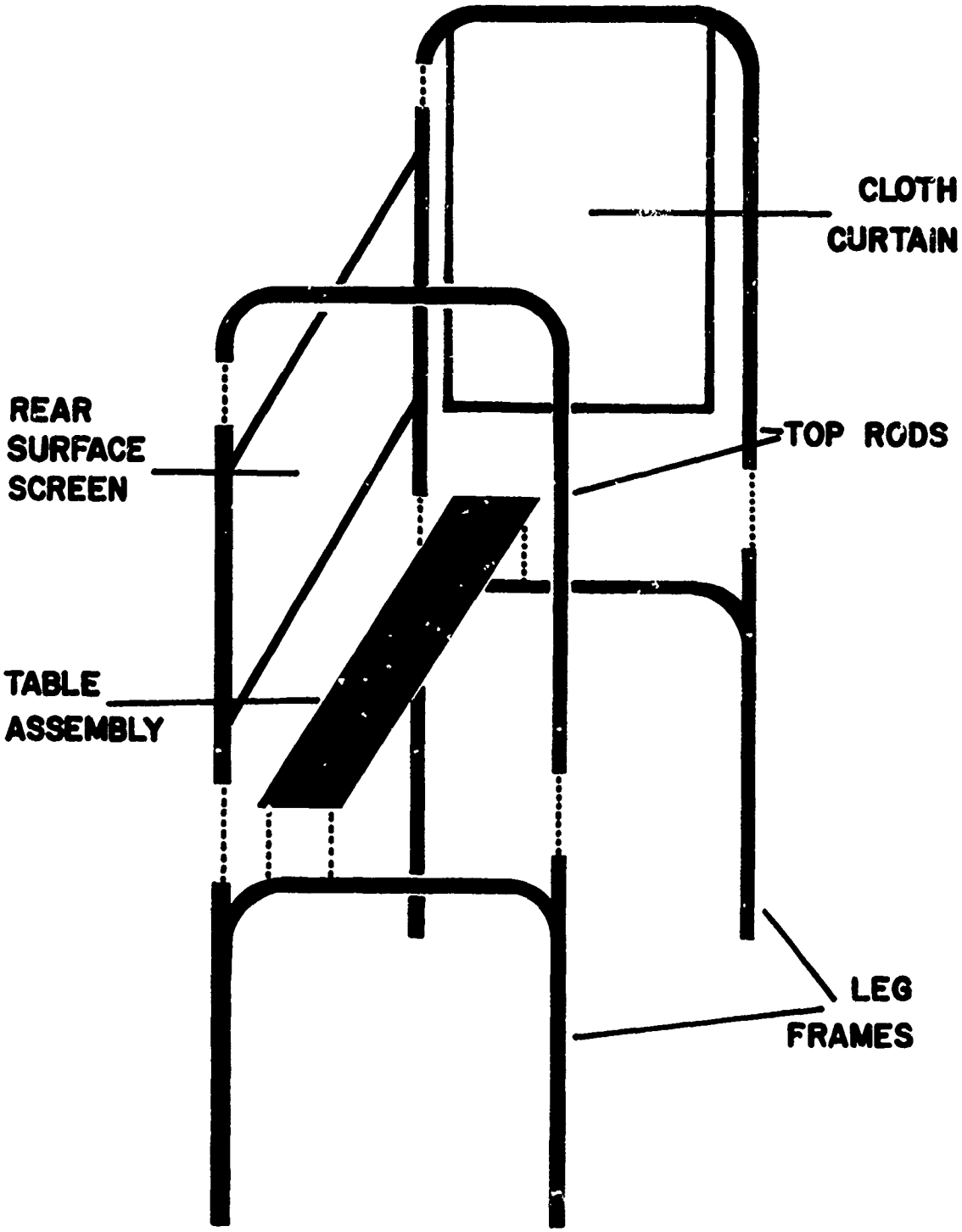


Figure 2. Assembly of FAC/TAC Trainer Student Booth

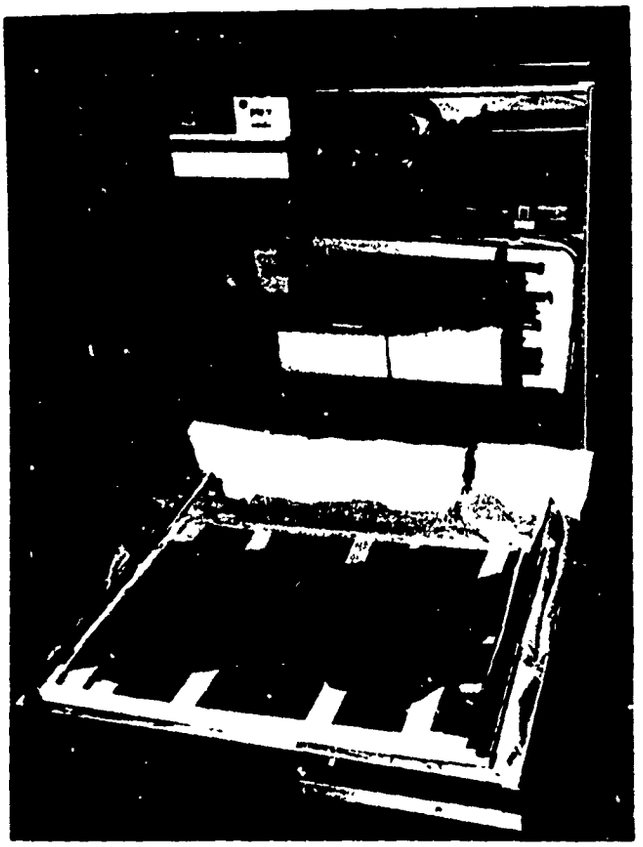


Figure 3. The Transportable Case Opened to Show Trainer Components

Figure 4. The Transportable Case Closed and Ready for Shipment.

and training objectives. A trainer need not duplicate operational equipment to have training value. However, a positive attitude toward the trainer on the part of the instructor is essential. The instructor should promote favorable attitudes on the part of the student toward the training he receives. If the student develops unfavorable attitudes toward the instruction and trainer, the attitudes may interfere with the acquisition of desired skills. A capable instructor can provide the student with supplementary information which will increase the effectiveness of a trainer even when it has only minimal cues.

TRAINER DESCRIPTION AND OPERATION

The trainer includes positions for the FAC, TAC, and instructor. It is constructed of lightweight aluminum tubing and rear projection screens. Other equipment includes a cassette tape recorder, two 35mm slide projectors, an audio amplifier, headsets, and a set of 35mm slides. Also, the 3 participants in the training session (FAC, TAC, and instructor) share an intercommunication (intercom) system and all communications may be tape-recorded by the instructor (Figures 5, 6, and 7). Playback of the recordings provides immediate feedback for the student as to the effectiveness of his description of target locations (Reference 5).

The target area, depicted on slides, is projected on the back of the FAC's and TAC's screens. The instructor uses a pointer, or a penlight, to indicate on the back of the FAC's screen the target to be described by the FAC to the TAC. The instructor turns on the tape recorder. The FAC then establishes contact with the TAC and begins transmitting target information to him. A sample tape recording of a FAC/TAC communication scenario is included with the trainer for demonstration purposes.

When power is on, both students and the instructor can speak to and hear each other through the headsets. If a student wishes to speak privately with the instructor, he presses his push button which lights the respective red light on the intercom set. The instructor pulls the toggle switch corresponding to that student and a two-way conversation is possible. When the toggle switch is released, three-way communications are reinstated.

Figure 5. FAC/TAC Trainer (Student Position)

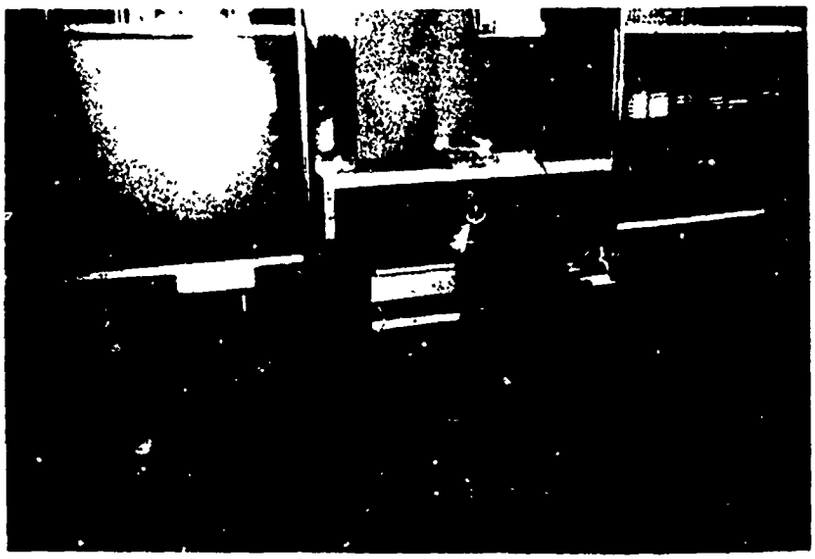


Figure 6. FAC/TAC Trainer (Instructor Position)

Figure 7. The Intercommunication Set

SECTION III

METHOD

TRAINER TEST IMAGERY

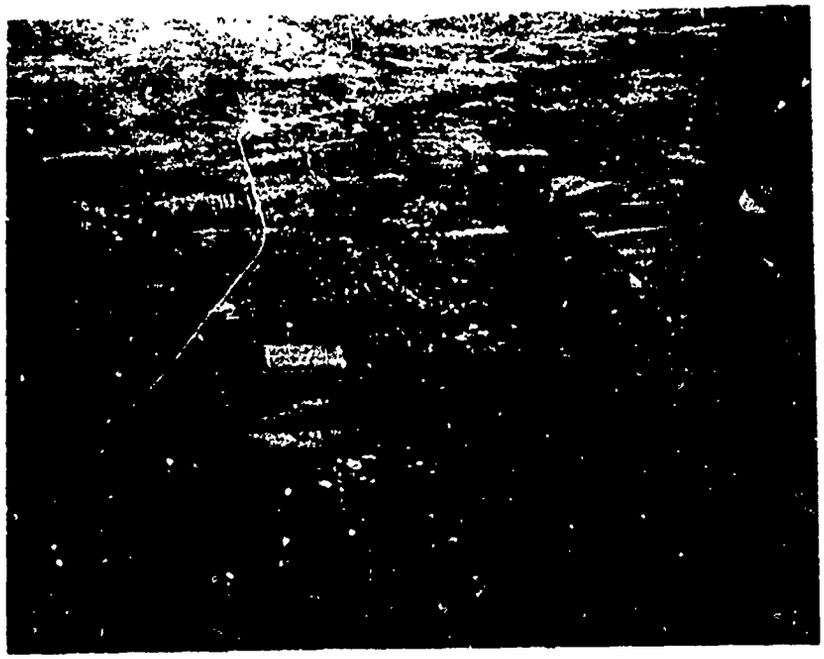
Photographic imagery which compensates for differences in FAC and TAC altitudes was used in the test. The altitudes as represented in the 35mm slides are 2,000 feet for the FAC's screen and 8,000 feet for the TAC's screen. Each scene for both FAC and TAC was photographed from (1) east, (2) north, (3) west and (4) south. The scenes were photographed in color from a Cessna 172 aircraft at 8,000 feet altitude. Two cameras, mounted side-by-side, were used to obtain the imagery. One camera, equipped with 50mm lens was used to photograph the TAC imagery (8,000 feet). Another camera, equipped with 200mm lens, was used to photograph the FAC imagery (2,000 feet, simulated). Both camera were operated simultaneously in photographing each scene. A sample of the imagery in black and white is shown in Figure 8.

SUBJECTS

A total of 35 Air Force pilots, selected to be trained as airborne forward air controllers, participated in the comparison study. The students were divided into 2 groups: Group A (N=18) and Group B (N=17). Group A received a one-hour pretest, two hours practice, and a one-hour posttest. Group B received only a one-hour pretest and a one-hour posttest. Their average total flying time was 651 hours. Because of conflicts in trainee entry and scheduling of training, it was necessary to randomly assign students for the experimental treatment. However, as a group, they proved to be homogeneous in terms of aptitude and experience. None previously had received specific training in the communication of target locations between forward air controllers and strike pilots. Therefore, differences in the performance of the two groups on the criterion test may be attributed to training experience.

EVALUATION PERSONNEL

Three experimenters conducted the test as follows: (1) one experimenter operated the tactical strike pilot position, (2) one experimenter operated the trainer instructor position, and (3) one experimenter conducted the supervised trainer practice sessions. Each experimenter retained the same trainer



A. Imagery Taken from 8,000 Feet (Looking South)

B. Imagery-Simulated 2,000 Feet (Looking South)

Figure 8. Sample of Photographic Imagery Used in the Experiment

assignment throughout the testing period. Each had wide experience in conducting Air Force training and testing programs.

The 1st Special Operations Wing, Hurlburt Field, was tasked by Tactical Air Command to provide monitorship of the test program and student scheduling for the experiment. Technical advice was provided the experimenters by combat experienced FAC and strike pilots assigned to the Tactical Air Command Air Ground Operations School at Hurlburt Field. The Air Ground Operations School also furnished classroom facilities for the testing sessions.

SECTION IV

PROCEDURE

DESIGN

The criterion test consisted of 2 sets of 10 color slides; one set of 10 slides for the FAC with a simulated altitude of 2,000 feet and another set of 10 slides for the TAC taken at 8,000 feet. The same number of slides of an equal order of difficulty were used for the pretest and practice session. The experimental design is shown in Figure 9.

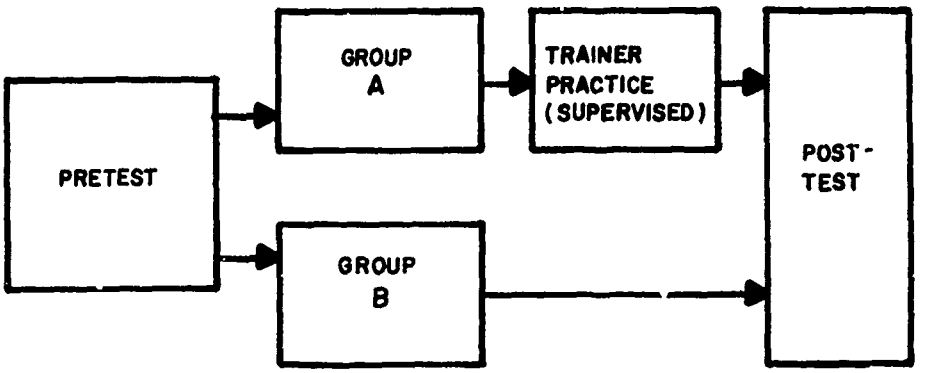


Figure 9. Experimental Design

PROGRAM ADMINISTRATION

The testing program was administered during scheduled class periods. The program consisted of 3 phases: (1) pretest, (2) supervised practice session, and (3) posttest. Group B did not participate in the supervised practice sessions. Group A and Group B subjects were pretested and posttested on an individual basis. Two Group A students received supervised practice on the trainer at the same time. Testing procedures were as follows:

Pretest

The student viewed Film Number SPR 17-71, "FAC/TAC Training Simulator,"color, 330 feet, 7 minutes. This film provided background on the development and use of the FAC/TAC trainer. The instructor played a briefing tape which consisted of test instructions (Appendix A) and a scenario of target location communications by an experienced FAC and strike pilot.

The instructor explained how to operate the trainer. He then gave the student a 3-inch x 5-inch card which bore the name of the target such as truck convoy, supply dump, or gun position. The card also indicated the cardinal direction toward which the student was looking (north, south, east, or west). The TAC also was given a card which only indicated the direction toward which he was looking. The student could mark directions on the screen with a grease pencil. The instructor used a pointer to indicate to the student the location of the target. Then, the student was instructed to begin. When the student established voice contact on the intercom with the experimenter operating the strike pilot (TAC) position, the instructor activated a stop watch. The instructor stopped the timing as soon as the FAC told the TAC to "mark" the target or when the FAC exceeded the 4-minute time limit. The instructor logged the time elapsed and the score. He scored the time as follows:

Time in Seconds	Score
0 - 60	4
61 - 120	3
121 - 180	2
181 - 240	1
*Over 240	0

*During the trainer tryout sessions, it was determined that most FAC subjects, using the same imagery as provided in the evaluation, successfully transferred target location information to the TAC in 4 minutes, or less, for each target.

Accuracy was scored by means of a plastic overlay which had a scale ranging from 0 to 5 imprinted on it as shown in Figure 10. The "5" ring is placed on the actual target location on the TAC's screen. If the TAC's target location mark fell within the "5" circle, the FAC student received a score of 5. If it was within the "4" circle, a score of 4 was given, etc. A score of 0 was given when the mark was outside the "1" circle. The student's total score was the combined time and accuracy score for the 10 targets. The total possible score was 90.

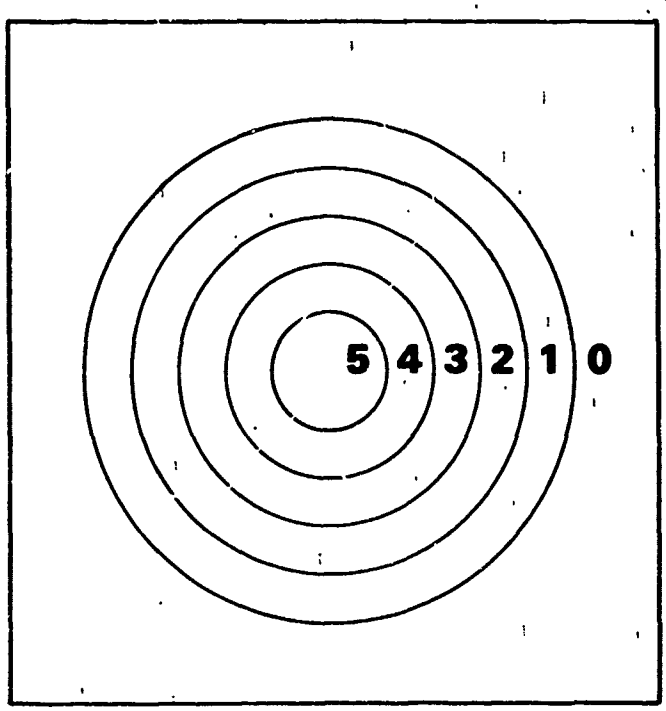


Figure 10. Accuracy Score Overlay

After completing the first target run, the student cleaned the grease pencil markings from the screen (lighter fluid is recommended by the screen manufacturer for this purpose). The instructor gave him a new card bearing the name of the second target and the direction toward which the student was looking. The test was terminated when the FAC student completed the 10-target schedule.

The targets used were imaginary because target indentification was not an objective of the test. The instructor indicated to the FAC student the presence of troop movements, gun emplacements, truck convoys, sampans, and other imaginary targets. However, the location of the target was realistic. For example, a sampan was on a stream, a moving truck convoy was on a road or trail, etc. Several targets could be used for each slide simply by changing locations and renaming the targets.

Supervised Practice Session

After pretesting, the Group A students performed in pairs for 2 hours on the practice trainer. They alternated roles, as FAC for 1 hour and as strike pilot for 1 hour. The students were instructed to work together as a team. This procedure differs from that used in the pretest and posttest. During those test periods, the FAC had to guide the TAC to the target without active assistance by the TAC. For example, the TAC confirmed landmarks or other information only when requested to do so by the FAC student.

The students worked through 20 targets during the 2-hour practice session which included 10 targets at the FAC position and 10 targets at the TAC position. For example, a student operated the FAC side of the trainer using 10 slides and 10 targets. He then assumed the TAC role and the TAC student operated as the FAC. The same slides with different targets were used. The students changed trainer positions when they alternated roles. The students were scored for their performance only as a FAC. The targets were scored in the same way as for the pretest and posttest. Scoring of the targets provided structure for the practice sessions as well as knowledge of results for the students. A team score for the 2 students during each practice session was derived as follows:

$$\frac{\text{Student (1) Score} + \text{Student (2) Score}}{2} = \text{Team Score}$$

Posttest

Both Group A and Group B students were posttested on the trainer. The posttest procedures were the same as for the pretest except that the trainer briefing film was not shown again.

Trainer Evaluation Questionnaire

After completing the posttest, each student was administered a questionnaire adapted from Labbe and Stordahl (Reference 6). The questionnaire was used to measure the student's general attitude toward the trainer (Appendix B).

Transfer of Training

Because the trainer evaluation had been superimposed on an existing stringent schedule, transfer of training from the trainer to aircraft was not included in the experimental design. However, prior to completion of the evaluation, arrangements were made by the 1st Special Operations Wing to obtain flight instructor appraisals on some of the students. A total of 8 Group A and 8 Group B students were rated by their instructors.

SECTION V

RESULTS

RATIO GAIN SCORES

One of the first considerations in the design of this experiment was to determine the gain in proficiency a student might achieve through practice on the trainer. Ratio gain scores were calculated for each subject for the pretest and posttest (Appendix C). The ratio gain scores were obtained by dividing the actual gain by the possible gain. The results can be used for comparison purposes. An example of the computation of a ratio gain score when the maximum possible score equals 90, is shown below:

Pretest score:	20
Posttest score:	60
Actual gain:	40
Possible gain:	70

$\frac{40}{70}$ = 0.57 (ratio gain score)

Table I shows the ratio gain scores for the 35 FAC students who participated in the comparison study. Each student is identified in terms of (1) his group (A or B), (2) his ratio gain score, and (3) the rank of his ratio gain score relative to the ratio gain scores of the other FAC students.

A Mann-Whitney U test* was calculated for the rank-order data to evaluate the difference in the achievement in gain between the two groups. The gain of Group A was significantly greater than that of Group B (Mann-Whitney U, $z = 2.475$, probability was greater than .05). A scatter plot of the ratio gain scores for the two groups is shown in Figure 11.

* This statistic (Reference 7) is a powerful nonparametric test because of its relative efficiency in rejecting the null hypothesis when the hypothesis is false. The null hypothesis tested by the Mann-Whitney U is that the independently drawn groups are samples of the same population.

TABLE I

RATIO GAIN SCORES FOR THE COMPARISON STUDY

STUDENT	TRAINING GROUPS		RATIO GAIN	RANK
1		B	67	1
2	A		62	2
3	A		60	3
4		B	58	4
5	A		56	6
6	A		56	6
7	A		56	6
8	A		55	8
9		B	52	9.5
10	A		52	9.5
11	A		51	11
12		B	49	12.5
13		B	49	12.5
14	A		48	14.5
15	A		48	14.5
16		B	47	16.5
17	A		47	16.5
18	A		46	19
19	A		46	19
20	A		46	19
21		B	45	21
22	A		42	22
23		B	40	24
24		B	40	24
25	A		40	24
26	A		29	26
27		B	27	27
28		B	25	28
29		B	24	29
30	A		21	30
31		B	20	31
32		B	19	32
33		B	18	33
34		B	0	34
35		B	-13	35

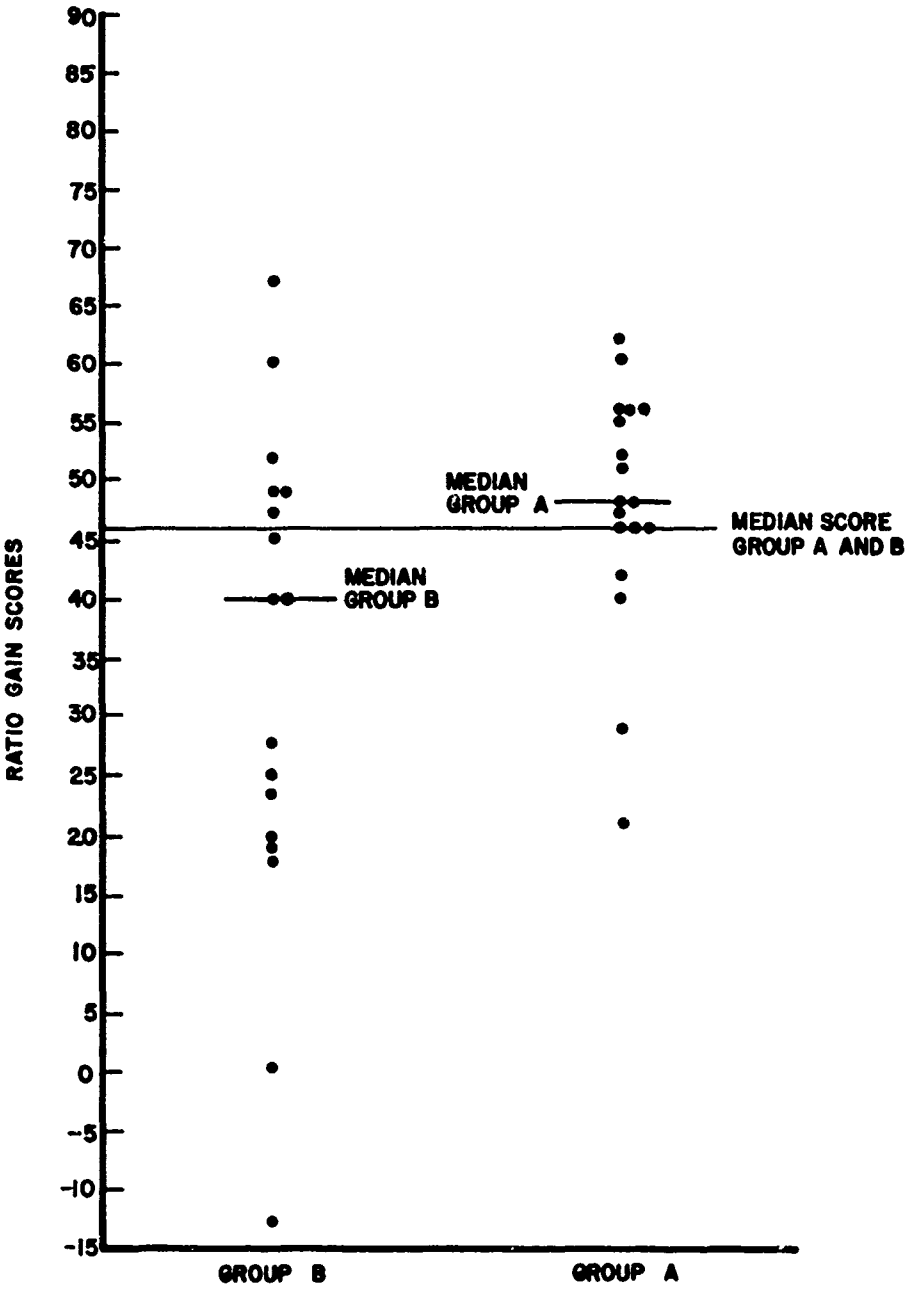


Figure 11. Scatter Plot of the Ratio Gain Scores

TARGET TRIALS ANALYSIS

The scores for each trial performed by Group A and Group B students were calculated and graphed. The pretest and posttest consisted of 10 trials each. The combined scores for the practice session show the effect of the 2 additional hours on the performance of Group A students.

Figure 12 is a graphic presentation of each pretest trial for the two groups. In the first 6 trials of all tests, the students used imagery with the same heading (students looking in the same direction). For example, north for FAC and north for TAC. On Trials 7 through 10, the headings were changed to north for FAC, and east for TAC, etc. Apparently, this change interfered (at least temporarily) with the students' orientation which, in turn, affected their performance unfavorably. The drop in performance for both groups during Trial 7 is shown in Figure 12.

During the practice session, the performance of Group A on Trial 7 was still adversely affected by the change in cardinal directions (Figure 13). On the posttest, however, Group A seems to have solved the problem associated with the 90° to 180° change in direction. A pronounced dip in performance for Group A does not appear on Trial 7 of the posttest (Figures 13 and 14). Performance by Group B on Trial 7 dipped sharply on the pretest and performance by this group was only slightly better for Trial 7 on the posttest. Apparently, the extra practice received by Group A was especially helpful on this problem (Figure 14).

TRAINER EVALUATION QUESTIONNAIRE

The Trainer Evaluation Questionnaire (adapted from Labbe and Stordahl, Reference 6) is included as Appendix B. The first 8 items on the 11-item questionnaire were intended to provide an indication of student satisfaction with the trainer. The remaining 3 items were concerned with how the student felt about (1) the difficulty of the training, (2) length of time spent in training, and (3) how much of the same training was previously received by the student.

A large majority of the FAC students who participated in the evaluation enthusiastically endorsed the use of the trainer in the forward air controller training program. Their responses to the 11 items on the questionnaire are presented as Appendix D.

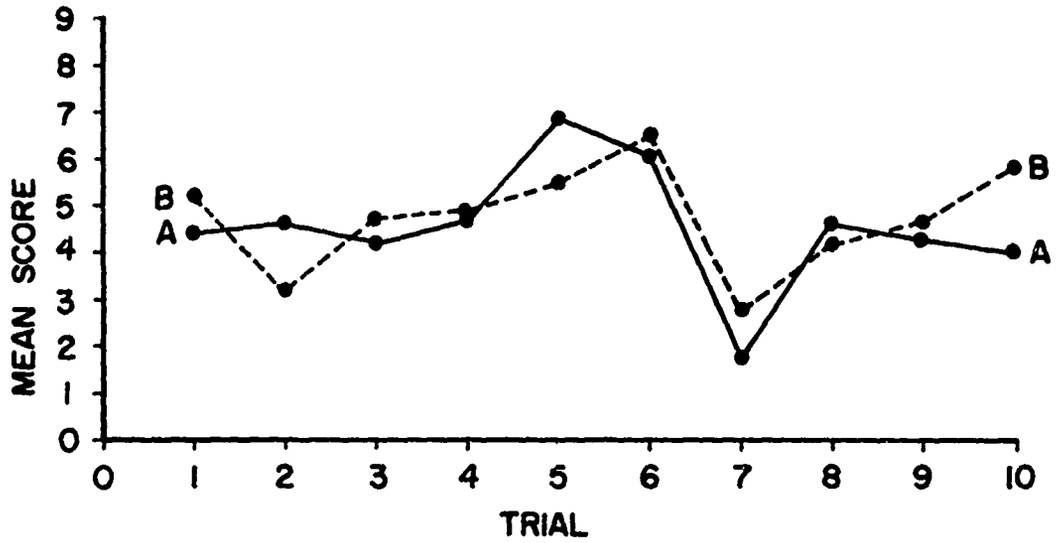


Figure 12. Graphic Presentation of Each Pretest Trial for the Two Groups

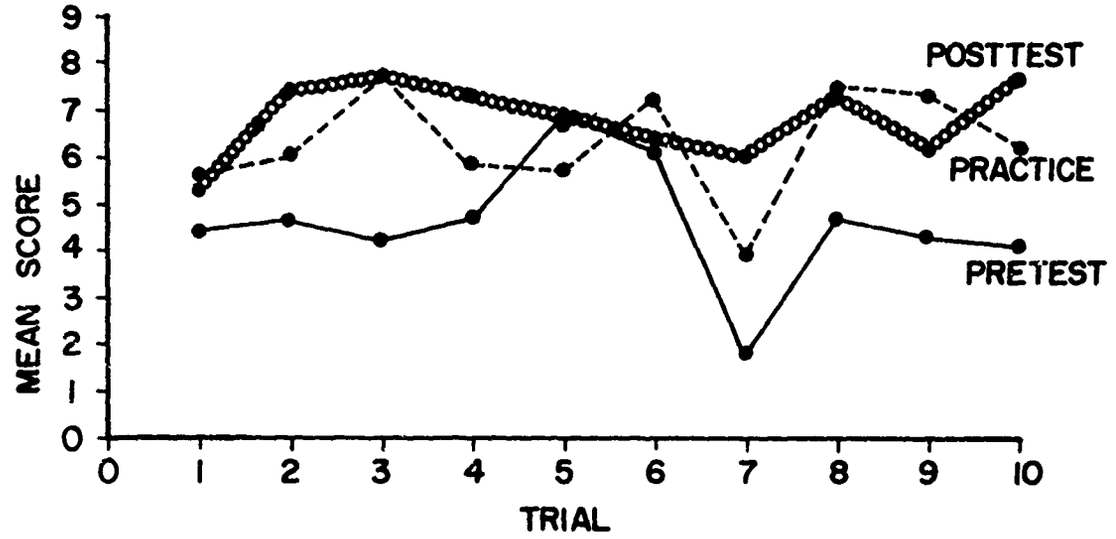


Figure 13. Graphic Presentation of Each Pretest, Practice, and Posttest Trial for Group A

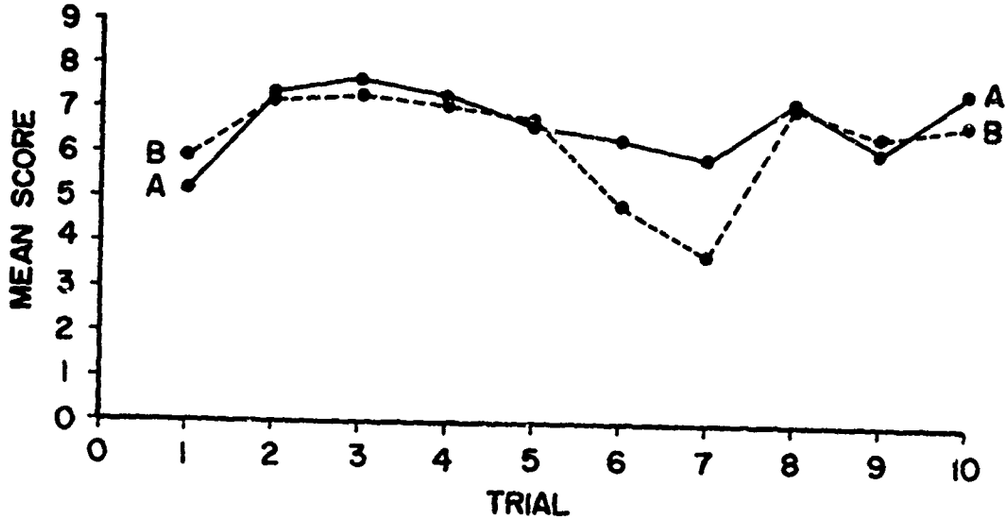


Figure 14. Graphic Presentation of Each Posttest Trial for the Two Groups

Students responding in the top 40% of the scale (favorable end) were given a score of 1 and those responding below the top 40% were given a score of 0. A total "general satisfaction" or "favorable attitude" score was obtained for each group of students from the first 8 items of the 11-item scale. The percentage of students responding in the top 40% of the scale was as follows: (1) Group A, 80.6% and (2) Group B, 80.1%.

Most of the students (27) expressed the opinion that the training content was not difficult. Although the testing varied from 4 hours for Group A to 2 hours for Group B, 10 Group A and 9 Group B students felt that the time spent in the training was adequate. Additional training time was felt needed by 8 Group A students and 6 Group B students. A total of 32 students responded that for them the training content was almost entirely new material, or that it only slightly overlapped with other training received. These students responses (items 9 through 11) are detailed in Appendix D.

TRANSFER OF TRAINING

As indicated in Section IV of this report, because of a tight flying training schedule, transfer of training from the trainer to the aircraft was not included in the experimental design. However, later it became possible to obtain flight instructor appraisals on some of the students (N=8 for each group).

The students were rated on how well they could: (1) estimate distance, (2) select good initial reference points, (3) communicate clearly, and (4) communicate concisely. In addition, the students were rated on how well they retained their composure (relaxed, not nervous) under time-sharing conditions in flight.

The ratings were completed by the students' instructor pilots. The instructors evaluated the students' performance against other students who had not been tested on the trainer. The maximum possible score was 30. The mean scores for Group A and Group B were 20.5 and 19.4 respectively. The difference between the means was not significant (Mann-Whitney U, $z = .488$).

Unfortunately, the tested groups did not provide a sufficiently wide base for a realistic evaluation. Also, the highly subjective checklist used by the instructors

optimally could differentiate only between gross levels of performance. However, the instructors were of the opinion that the FAC/TAC trainer provided an added benefit to the overall OV-10 and O-2 training program.

SECTION VI

SUMMARY AND CONCLUSIONS

METHOD

Field research seldom attains the desired controlled conditions of laboratory experiments and this effort was no exception. For example, it was not administratively feasible to obtain the training records of the FAC students. Therefore, it was not possible to assign precisely matched pairs to treatment groups. For this reason, the two groups (Group A and Group B) were randomly assigned. Subsequent analysis indicated that no significant differences existed between the two groups as measured by performance on the pretest.

TRAINER EVALUATION RESULTS

The results of the FAC/TAC trainer evaluation indicate that the trainer can be used to teach FACs how to tell TACs of the location of targets. During the initial tryout and the subsequent field evaluation, it became apparent that some of the major factors affecting the task were:

- judgments of distance
- judgments of direction
- amount of scene structure
- observer's cardinal direction orientation
- observer's altitude
- generalizability of landmarks
- color contrasts

The trainer can provide practice in each of the above factors if suitable imagery is used. These factors were included as task elements of the performance trials in the trainer evaluation.

The variations in performance on the various trials may enable the instructor to determine and correct student errors in performing certain task elements such as distance estimation, judgments of direction, etc. For example, the low scores obtained by Group A and Group B students on Trial 7 (Figure 12) were caused by a 90° change in direction (North for the FAC and East for the TAC). On previous trials, the

headings were identical for both FAC and TAC positions. For Trials 7 through 10, the directions were changed by 90° and 180°.

STUDENT ACCEPTANCE OF THE TRAINER

The students participating in the trainer evaluation were administered a questionnaire in an attempt to assess their attitude toward the trainer. The value of opinion data depends largely upon the number and qualifications of personnel giving the opinions. Because the students had practiced in the trainer from 2 to 4 hours, it was presumed that they were qualified to judge whether or not they favored the use of the device in the FAC training program.

In general, the students enthusiastically endorsed the use of the trainer to provide skills in communicating target locations to strike pilots. Of the 35 students responding to the questionnaire, only 3 held negative attitudes toward the trainer.

CONCLUSIONS

The results of this study have implications for training both FACs and TACs in transfer of target information by voice communications. During the supervised practice session, the students operated the trainer as two-man teams by alternating FAC/TAC roles. The students' performance scores for 10 trials (practice), as presented in Figure 13, shows that the students could effectively transfer target location information while operating the trainer as teams.

A few of the inexperienced FAC students demonstrated an unusual ability to start with easily seen, gross landmarks and then quickly lead the TAC listener to the target. They accomplished this by clearly specifying figure/ground relationships in the visual scene with a minimum number of statements. This ability on the part of some experienced FACs also was observed during a tryout of the trainer (Reference 4). A detailed analysis of the cues and procedures used by outstanding students in the trainer may reveal certain techniques that are worthy of training.

The FAC/TAC trainer was designed to be used as a part-task trainer. It was not intended to provide practice for all tasks related to the FAC/TAC operation. The trainer proved to be an effective instructional device when used to achieve its stated purpose. It was not designed to supplant necessary flight training in the overall FAC/TAC mission. It can be used, however,

to increase proficiency in transfer of target location information from the FAC to the TAC in ground-based training. Logically, it appears to be possible to use the trainer to instruct pilots in other facets of the FAC/TAC operation, but further experimental data is needed to support such use of the device.

APPENDIX A

TEST INSTRUCTIONS

The purpose of this experiment is to evaluate the effectiveness of this simulator in training forward air controllers to accurately transmit target locations to other personnel in the least possible time. You will be given a test which consists of 10 different target locations. Describe each target location to the operator in the compartment to your right. The instructor will provide you with the targets 1 at a time. Approximately 50 minutes will be required to complete the test. You will be allowed a maximum of 4 minutes per target. If you exceed 4 minutes on a target, the instructor will call you on the intercom and say "cease communications". He then will give you the next target. The procedures you should use are as follows:

1. The instructor will call you on the intercom and tell you what the target is; for example, gun position, truck, etc. He will then mark the target location for you on the screen.

2. When the instructor provides you with a target, immediately call the other operator and inform him that you have a target for him. Your call sign and his call sign are on a card at your position. When he answers, begin verbally leading him to the target. Answer his requests for additional information or confirmation until he says, "I have the target".

3. When the other operator says that he has the target, the instructor will record the elapsed time. Also he will score the accuracy of your voice communications by measuring with an overlay how near the other operator was able to approach the target following your instructions.

4. Remember that the other operator, although experienced on the trainer, does not know the locations of the targets beforehand. Therefore, you must lead him to each target in the shortest possible time. You may use any outstanding features to lead him to the target, such as a bend in a river, highways, houses, power stations, compass directions, etc. If an object looks like a doughnut, Christmas tree, geometrical shapes such as triangles, circles, squares, etc., you may use these analogies if you think they will assist you in transmitting target location information.

5. Your score will depend upon the number of targets completed in the allotted time and by how near the other operator strikes the target. Therefore, you should work as rapidly and accurately as you can.

The following taped scenario will give you some idea of how communications between the FAC and strike pilot may be conducted. However, you may verbalize target locations as you wish. Efficient communication is your primary objective.

(The instructor plays the taped scenario.)

Do you have any questions?

APPENDIX B

TRAINEE EVALUATION OF TARGET LOCATIONS COMMUNICATIONS TRAINING

DIRECTIONS

You have just completed approximately four hours of target locations communications training on the forward air controller trainer. You can help Tactical Air Command evaluate the effectiveness of the trainer by answering the questions in this booklet. This questionnaire contains some questions about your reactions to this training. Please read the questions carefully and answer them as frankly as you can.

Read each item carefully and select the response that best represents your feelings about the training. Then record your response by circling the letter in the booklet which corresponds to that answer. If you want to change an answer, erase your first circle completely. Be sure to read all responses before making your choice.

Please print your last name and initials on the booklet. Place the booklet in the envelope which has been provided and seal it. The answers you give will be regarded as confidential by the evaluation team and no one connected with the school will read them.

NAME _____

HOURS _____

1. How beneficial do you think this training will be to you as a FAC?

   A. Very beneficial
   B. Helpful
   C. Of some use
   D. Little gained from it
   E. Benefits gained do not justify its existence

2. How do you feel about taking this training?

   A. It was a waste of my time
   B. Sorry I took it
   C. Indifferent
   D. Somewhat glad I took it
   E. Very glad I took it

3. How practical was the training for you?

   A. Not practical
   B. Should be more practical
   C. Undecided
   D. Quite useful
   E. Very practical

4. How important was this training to the work that most of the trainees will do in their next assignment?

   A. Very important
   B. Quite important
   C. Of some importance
   D. Of slight importance
   E. Of no importance

5. How much do you feel you have learned from this training?

   A. A great deal
   B. More than average
   C. About average
   D. Very little
   E. Almost nothing

6. How interesting was this training?

   A. Very interesting
   B. Quite interesting
   C. Mildly interesting
   D. Somewhat boring
   E. Very monotonous

7. How satisfied have you been with this training?

   A. Highly dissatisfied
   B. Generally dissatisfied
   C. Somewhat satisfied - somewhat dissatisfied
   D. Generally satisfied
   E. Highly satisfied

8. How do you feel about the difficulty of the content of the training?

   A. Very difficult
   B. It gave me some trouble
   C. Not too difficult - not too easy
   D. Rather easy material
   E. Much too simple

9. How do you feel about the length of time spent in the training?

   A. Much too long
   B. Training time could be shortened
   C. Present length is just about right
   D. Would help to add a little more time
   E. Should have much more instruction

10. How much of the training content have you had in other courses?

   A. Entirely a repetition of other courses
   B. Largely a repetition of other courses
   C. Moderate (about half) amount of repetition
   D. Only slight overlap with other courses
   E. Almost entirely new material

11. How do you feel about using the FAC trainer to teach target location communications in FAC training?

A. Such training is not needed
B. Of little value
C. Moderately useful
D. Quite useful
E. Very valuable

APPENDIX C

Ratio Gain Scores

RATIO GAIN SCORES

GROUP A

Pre-Test	35	40	37	39	49	43	44	35	43	62	45	63	53	43	56	63	56	17
Post-Test	57	61	66	54	68	65	68	66	72	75	70	76	70	71	75	76	63	54
Actual Gain	22	21	29	15	19	22	24	31	29	13	25	13	17	28	19	13	7	37
Possible Gain	55	50	53	51	41	47	46	55	47	28	45	27	37	47	34	27	34	73
Ratio Gain	40	42	55	29	46	47	52	56	62	46	56	48	46	60	56	48	21	51

GROUP B

Pre-Test	29	46	48	55	53	30	70	33	68	55	59	44	45	58	53	45	20	
Post-Test	59	67	56	62	63	57	70	71	72	69	55	68	71	66	62	67	48	
Actual Gain	30	21	8	7	10	27	0	38	4	14	-4	24	26	8	9	22	28	
Possible Gain	61	44	42	35	37	60	20	57	22	35	31	46	45	32	37	45	70	
Ratio Gain	49	47	19	20	27	45	0	67	18	40	-13	52	58	25	24	49	40	

APPENDIX D

Frequency Distributions: Trainee Evaluation of Target Location Communications Training

GROUP	a. Very beneficial	b. Helpful	c. Of some use	d. Little gained from it	e. Benefits gained do not justify its existence	
	FREQUENCY					
A	10	6	1	1	0	N=18
B	8	7	1	1		N=17
TOTAL	18	13	2	2	0	N=35

1. HOW BENEFICIAL DO YOU THINK THIS TRAINING WILL BE TO YOU AS A FAC ?

GROUP	a. It was a waste of my time	b. Sorry I took it	c. Indifferent	d. Somewhat glad I took it	e. Very glad I took it	
	FREQUENCY					
A	0	0	2	5	11	N=18
B	0	0	3	4	10	N=17
TOTAL	0	0	5	9	21	N=35

2. HOW DO YOU FEEL ABOUT TAKING THIS TRAINING ?

GROUP	a. Not practical	b. Should be more practical	c. Undecided	d. Quite useful	e. Very practical	
	FREQUENCY					
A	1	0	2	8	7	N=18
B	0	1	3	6	7	N=17
TOTAL	1	1	5	14	14	N=35

3. HOW PRACTICAL WAS THE TRAINING FOR YOU ?

GROUP	a. Very important	b. Quite important	c. Of some importance	d. Of slight importance	e. Of no importance	
	FREQUENCY					
A	7	6	5	0	0	N=18
B	7	6	3	0	1	N=17
TOTAL	14	12	8	0	1	N=35

4. HOW IMPORTANT WAS THIS TRAINING TO THE WORK THAT MOST OF THE TRAINEES WILL DO IN THEIR NEXT ASSIGNMENT ?

GROUP	a. A great deal	b. More than average	c. About average	d. Very little	e. Almost nothing	
	FREQUENCY					
A	6	9	2	1	0	N=18
B	3	8	4	2	0	N=17
TOTAL	9	17	6	3	0	N=35

5. HOW MUCH DO YOU FEEL YOU HAVE LEARNED FROM THIS TRAINING ?

GROUP	a. Very interesting	b. Quite interesting	c. Mildly interesting	d. Somewhat boring	e. Very monotonous	
	FREQUENCY					
A	9	7	2	0	0	N=18
B	9	6	2	0	0	N=17
TOTAL	18	13	4	0	0	N=35

6. HOW INTERESTING WAS THIS TRAINING ?

GROUP	a. Highly dissatisfied	b. Generally dissatisfied	c. Somewhat satisfied-somewhat dissatisfied	d. Generally satisfied	e. Highly satisfied	
	FREQUENCY					
A	0	0	1	9	8	N=18
B	0	2	1	5	9	N=17
TOTAL	0	2	2	14	17	N=35

7. HOW SATISIFIED HAVE YOU BEEN WITH THIS TRAINING ?

GROUP	a. Very difficult	b. It gave me some trouble	c. Not too difficult-not too easy	d. Rather easy material	e. Much too simple	
	FREQUENCY					
A	0	3	10	4	1	N=18
B	0	5	8	3	1	N=17
TOTAL	0	8	18	7	2	N=35

8. HOW DO YOU FEEL ABOUT THE DIFFICULTY OF THE CONTENT OF THE TRAINING ?

GROUP	a. Much too long	b. Training time could be shortened	c. Present length is just about right	d. Would help to add a little more time	e. Should have much more instruction	
	FREQUENCY					
A	0	0	10	6	2	N=18
B	0	2	9	3	3	N=17
TOTAL	0	2	19	9	5	N=35

9. HOW DO YOU FEEL ABOUT THE LENGTH OF TIME SPENT IN THE TRAINING ?

GROUP	a. Entirely a repetition of other courses	b. Largely a repetition of other courses	c. Moderate (about half) amount of repetition	d. Only slight overlap with other courses	e. Almost entirely new material	
	FREQUENCY					
A	0	0	1	9	8	N=18
B	0	1	1	7	8	N=17
TOTAL	0	1	2	16	16	N=35

10. HOW MUCH OF THE TRAINING CONTENT HAVE YOU HAD IN OTHER COURSES ?

GROUP	a. Such training is not needed	b. Of little value	c. Moderately useful	d. Quite useful	e. Very valuable	.
	FREQUENCY					
A	0	1	3	10	4	N=18
B	1	1	1	7	7	N=17
TOTAL	1	2	4	17	11	N=35

11. HOW DO YOU FEEL ABOUT USING THE FAC TRAINER TO TEACH TARGET LOCATION COMMUNICATIONS IN FAC TRAINING ?

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